

DRAFT

DROUGHT IMPACT EVALUATION OF HOOVER, PARKER & DAVIS DAM GENERATION

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By

U.S. Department of the Interior

Bureau of Reclamation¹

Lower Colorado Region

Introduction

Presently, we are continuing into the fifth year of a severe drought of yet unknown duration. Reclamation is engaged in determining the current and future effects on power generation in the event dry weather patterns persist. The purpose of this report is to quantify current and future effects to our power customers resulting from the drought.

Drought Effects to Lake Mead

Lake Mead water surface elevation has a significant effect on Hoover's generation capability. The rated generating capacity of Hoover Dam is 2,074 megawatts when Lake Mead is above elevation of 1203 feet. Because of the declining lake level, Hoover Dam has been de-rated to 1,731 megawatts. This reduction in capacity is projected to continue as the lake level declines. As of August 5, 2004, Lake Mead was at 1125.85 feet. Before 1981, minimum power pool elevation was 1083 feet. The up-rated turbines enabled the minimum power pool elevation to be lowered to approximately 1050 feet. Generation below 1050 feet could cause serious damage to the generator turbines and would need to be evaluated on a case-by-case basis. Lake Mead is 76 feet above the 1050 foot elevation.

Significant Hoover Elevations:

Crest of Dam	1232
Top of spillway gates in raised position	1221.4
Current lake elevation (August 5, 2004)	1125.85
Minimum power pool	1050
Lake bottom per 1963 sedimentation study	720

If the drought continues, Reclamation currently estimates it would take at least four years at current operating levels to reach the top of minimum power pool, assuming the Colorado River Basin continues to experience the type of dry conditions it has experienced during the past five years. If hydrologic or water use conditions change, this estimate would also change.

Hoover Power Generation

Generating Capacity

Annually, Hoover Dam generates an average of 4.0 to 4.5 billion kilowatt-hours of electric energy. In general, this amount of energy could supply all of the electrical needs for 300,000 average-sized homes for one year. Generation is computed on a water year, October 1 through September 30. The highest annual power generation, 10.8 billion kilowatt-hours, occurred in 1984. The lowest, 2.65 billion kilowatt-hours, occurred in 1956. Projected 2004 generation is 4.08 billion kilowatt-hours. Reference Attachment A provides data for years 1997 through 2006 for comparison.

Power Revenues

Power revenues from Hoover and the Parker-Davis Project are split into three funds called the Lower Colorado Basin Development Fund (Development Fund), Colorado River Dam Fund (Dam Fund), and the Reclamation Fund. The Development Fund collects surplus revenue from the Navajo Generating Station, surcharge revenues from Hoover and Parker-Davis Project power sales, and from Central Arizona Project (CAP) water revenues. The Development Fund revenues are utilized for defraying CAP project operation, maintenance and replacement costs, repayment of CAP construction, and for support of salinity control programs. The Dam Fund collects from Hoover energy and capacity sales, visitor facility revenues, miscellaneous and sale of water revenues. The Dam Fund is utilized for operation, maintenance and equipment replacement of the dam and power plant, payments to the states of Arizona and Nevada in lieu of taxes, provide partial funding for the Lower Colorado River Basin Development Fund, and for the Hoover-related administrative costs of Western Area Power Administration (Western), which markets and delivers the power generated at Hoover Dam and manages contracts with the customers. The Reclamation Fund collects power revenues from Parker-Davis Project power sales and is not affected or referenced further in this report.

The Hoover power revenues which accrue must equal the costs over the fiscal year. Hoover Dam collects approximately \$52 million per year that goes into the Dam Fund, plus \$13 million that goes into the Development Fund. If generating capacity declines during the year, power rates adjust up the next year.

Power rates are set at a level that allows revenues to cover the costs noted above. There is no profit or loss. The current rate for Hoover is approximately 1.54 cents per kilowatt-hour for California and Nevada customers, and 1.74 cents per kilowatt-hour for Arizona customers, an average composite rate of 1.60 cents per kilowatt-hour. This rate includes a surcharge that if deducted, the contractors in all three states pay approximately 1.29 cents per kilowatt-hour.

Hoover Power Users

Hoover power is marketed and delivered to Arizona, Nevada and California by Western Area Power Administration (Western). A large number of the entities are cities, power distribution companies, and irrigation projects. The major customers and the percentage of firm energy allocated to each are:

• Arizona Power Authority	18.9%
• Nevada (Colorado River Commission)	23.4%
• City of Los Angeles	15.4%
• Metropolitan Water District of Southern California (MWD)	28.5%
• Southern California Edison	5.54%
• Burbank, CA	.59%
• Glendale, CA	1.59%
• Boulder City	1.77%
• Pasadena, CA	1.36%
• Riverside, CA	.86%
• Azusa, CA	.11%
• Anaheim, CA	1.15%
• Banning, CA	.044%
• Colton, CA	.088%
• Vernon, CA	.62%

Declining Water Elevation Impacts (Hoover)

If costs remain the same, and Lake Mead falls to an elevation of 1050 feet, the power rates will need to be increased to approximately 2.02 cents per kilowatt-hour, a composite rate (with surcharge) of 2.31 cents per kilowatt-hour, to maintain the required revenue. This represents to the customer a 44.3 percent rate increase from the current average composite rate noted above.

Replacement Power Purchases

Assuming that Hoover customers replace lost hydroelectric power from Hoover Dam at prevailing market rates, Arizona customers could pay about 5 cents per kilowatt-hour for replacement power which is 2.9 times more than the current Hoover rate, while Nevada and California customers could pay approximately 5.5 cents per kilowatt-hour for replacement power which is 3.7 times more than the Hoover power rate. These amounts are based on the August 2004 Palo Verde, Mead and SP15 indexes. For fiscal year 2003, replacement power purchases may have cost Hoover customers an additional \$24 million. Customers may have other resources and may find ways to reduce these costs, for example, by entering into long-term contracts. Hoover power resources are distributed such that this impact does not have a devastating impact to any single customer.

If Hoover can produce no power, the power customers may be required to make full supplemental electrical purchases at prevailing market rates that today are more than triple the current costs of Hoover's power, as previously noted above.

Development Fund Impacts

Development Fund income from the Hoover CAP-surcharge revenues have also been affected by the reduction in Hoover capacity. In fiscal year 2003, Hoover power revenues provided \$12,755,161 to the Development Fund, of which \$4.6 million supports the Central Arizona Project (CAP) and 8.2 million supports the Colorado River Basin Salinity Control Program (Salinity). Parker-Davis Project customers will begin paying this surcharge next year. Hoover customers pay based on the energy they actually receive. If they receive less energy, less revenue is available for CAP/Salinity repayment. For fiscal year 2003, Hoover customers received approximately 347,171,000 kilowatt-hours less than the projected contract amount of 4,501,001,000 kilowatt-hours, amounting to a 7.7 percent loss or approximately \$1,000,000. Projections of potential future Development Fund losses are shown in the Hoover Estimated Data Chart Using Declining Water Elevation in Reference Attachment B.

Ancillary Service Impacts

Traditionally, hydroelectric resources provide not only raw power, but also play key roles in providing power system stability and security (ancillary services). Outside of Reclamation, ancillary services that were once bundled with raw power may be separated and valued as distinct products that can be marketed. The Federal Energy Regulatory Commission (FERC) determined these products and services to be necessary to maintain reliability in a competitive deregulated market.

Ancillary services have high value and are generally defined to be regulation and reserve services. A study of Hoover regulation and reserve production during June 2000 indicated that Hoover can produce approximately 1.3 megawatts of regulation per megawatt-hour of energy produced and 0.8 megawatts of reserve per megawatt-hour of energy produced. Regulation is normally worth the most of all the ancillary services provided, making up to 60 to 80 percent of the total ancillary service value.

As a result of capacity loss due to lower lake elevation, Hoover customers have less regulation and reserves available, which may require supplemental purchases at prevailing market rates. In attempting to quantify in dollars the impact of this purchase, we will assume that ancillary service production impacts to Hoover are proportional to Hoover's current capacity loss of 343 megawatts, or 16.5 percent. Ancillary service prices are volatile over daily, weekly and seasonal periods, and difficult to estimate. Markets show that the price of ancillary services can vary from one dollar to 400 dollars per megawatt. Often the more stable upper prevailing market value for capacity is utilized for this estimate which for August 2004 was \$4 per megawatt. Utilizing this information, we estimate that supplemental purchases for lost regulation and reserves could approximate \$8 million.

Surplus Revenue Impacts

The reduction of Hoover surplus water generation has also had a large impact on the Development Fund revenue amounts. Hoover contractors paid, on average, \$3 million into the Development Fund each of the last five years, as depicted in the Hoover Dam Historical/Future Projections, Reference Attachment A. From fiscal year 1996 through fiscal year 2002, Hoover customers received surplus generation ranging from 5 to 28 percent of the contract amount.

Parker-Davis Project Power Generation

Generation Capacity

Parker and Davis Dam combined rated generated capacity is 375 megawatts. On average, Parker Davis Project generates 1.3 to 1.5 billion kilowatt-hours of electric energy annually. Projected fiscal year 2004 generation is 1.4 billion kilowatt-hours. The attached Parker-Davis Project Generation and Surplus table (Reference Attachment C) provides data for years 1996 through 2005 for further reference and comparison.

Parker-Davis Project power is marketed and delivered to Arizona, Nevada and California by Western. A large number of the entities are cities, power distribution companies, irrigation projects, military and tribes. The major Parker-Davis Project customers and the percentage of firm energy allocated to each are:

Arizona Power Authority	8.4	Edwards Air Force Base	6.5
Arizona Electric Power Cooperative		Electric District 1	.8
City of Mesa		Electric District 3	1
Colorado River Commission Several Customers	19.8	Fort Mohave Indian Tribe	.7
Colorado River Indian Reservation	3	Town of Fredonia, AZ	.6
DOE/Nevada Test Site	.8	Yuma MCAS	.8
Luke Air Force Base	.9	Imperial Irrigation District	11.7
Gila Bend Air Force Base	.2	March Air Reserve Base	1.7
City of Needles	1.8	Salt River Project	11
Nellis Air Force Base	1.1	San Carlos Indian Project	6.1
Tohono O'Odham Utility Authority	1	City of Thatcher	.1
Wellton-Mohawk Irrigation and Drainage District	1.1	City of Wickenburg, AZ	.7
Yuma Irrigation District	.3	Yuma Proving Ground	1.9
Aggregate Power Managers		MWD receives one-half of the power produced at Parker Dam and not included herein as a Preference Customer	
Wellton-Mohawk	12.9		
Yuma County Water Users' Assn	1.6		

Due to river operation constraints, power production at Parker and Davis is not currently impacted. Similar impacts would result as noted for Hoover, if; a) Lake Havasu (Parker Dam) and Lake Mohave (Davis Dam) water elevations are allowed to be affected; or, b) if the drought were to result in a shortage declaration causing a reduction in the water releases through these dams. Except for the elimination of surplus water, neither of these listed impacts is expected in the immediate future. Operational constraints continue to hold the elevations of these lakes within a narrow range. The lake elevations on Lake Mohave and Lake Havasu continue to be based on operation constraints developed to allow for these lakes to be drawn down during the fall and winter months to provide for storage space for local storm runoff and to be filled through the spring to meet higher summer water needs.

Parker-Davis Project Customer Rates

Parker-Davis Project customers currently pay approximately 0.56 cents per kilowatt-hour for power. In fiscal year 2005, the customers will begin to pay the added surcharge that Hoover customers currently pay. If this rate remains unchanged in fiscal year 2005, the added surcharge will increase Parker-Davis Project customer rates to 1.01 cents per kilowatt-hour for Arizona customers and 0.81 cents per kilowatt-hour for Nevada. These increases are not drought related.

Other Power Impacts

Black Start Capability

In the event of a power blackout in the Western United States, Hoover can be relied upon to bring its own generating units on-line without outside electrical support and can energize a defined portion of the transmission system. This in turn will allow other generators to be brought back on-line. Loss of Hoover generating capacity could affect black start capabilities for the power grid.

Voltage Support

Without sufficient water to run at least one generating unit at Hoover, there will be no voltage support available and could severely restrict power exports to California and Arizona.

System Stability in Outage Conditions

The complete loss of Hoover generation will affect system stability because of the loss of voltage support.

Transmission System Availability

Transmission impacts to the grid would be significant without Hoover generation. There may be added congestion in various Western transmission systems. Reduced power plant capacity at Hoover makes it more difficult to operate the control area. The probability of Western needing to purchase capacity to provide reserves and regulation for control area operations increases.

Conclusion

The results of the severe drought on Lake Mead elevations and on capacity and energy production give reason for concern. The impacts to Hoover generation are summarized as follows:

- Potential for replacement power purchases at high cost
- Loss of regulation and reserves and their high replacement cost
- Loss of significant Development Fund revenue
- Loss of surplus power generation and water releases
- High probability of rate increase and less customer avoided cost
- Detrimental effects on the transmission grid
- Detrimental effects on voltage support and control area operation

Although these impacts are significant, taking into perspective the current overall supply of energy and capacity and its distribution among the power customers, these impacts are currently not devastating to any single customer or to the transmission grid as a whole.

The impacts to the Parker-Davis Project are less significant. Lake Havasu and Lake Mohave should remain within traditional operational elevations and contract required flows.

Hoover Dam Historical/Future Projections Data Chart

Year	Avg Mead	Capacity Avg	Energy	Water for Generation	Composite Rate	Revenue Requirement	Development Fund
Y	FT	kW	kWh	AF	Cents/kWh	\$	Surcharge
1997	1204.51	2,074,000	5,284,240,133	11,111,391	1.022	\$44,437,488	\$15,442,540
1998	1213.66	2,074,000	5,768,414,091	11,926,450	.851	\$43,479,183	\$17,339,742
1999	1210.18	2,074,000	5,507,263,269	11,371,433	.943	\$48,842,126	\$17,188,028
2000	1205.35	2,071,000	5,292,847,603	10,978,315	.890	\$46,173,770	\$16,116,154
2001	1187.34	2,066,083	4,916,166,285	10,476,840	.975	\$47,788,574	\$15,848,104
2002	1165.07	2,003,000	4,733,708,248	10,493,969	1.032	\$48,039,988	\$13,047,511
2003	1147.07	1,883,500	4,093,567,541	9,450,647	1.116	\$50,761,729	\$12,755,161
2004	1134.43	1,800,058	4,088,100,000	9,646,000	1.291	\$51,719,075	\$11,769,861
2005	1120.04	1,678,517	3,892,200,000	9,233,000	1.482	\$57,654,682	\$11,205,854
2006	1111.37	1,635,833	3,755,205,353	8,948,469	1.643	\$61,694,939	\$10,811,439

2003 Western deemed delivered 4,153,000 megawatt-hours

Hoover Estimated Data Chart Using Declining Water Elevations

Elev FT	Capacity kW	Energy kWh	Composite Rate Cents/kWh	Revenue Requirement Based on 05	Development Fund Surcharge
1110.00	1,618,840	3,687,070,274	1.564	\$57,654,682	\$10,615,274
1105.00	1,587,479	3,615,641,328	1.595	\$57,654,682	\$10,409,627
1100.00	1,556,370	3,544,788,759	1.626	\$57,654,682	\$10,205,638
1095.00	1,525,516	3,474,514,584	1.659	\$57,654,682	\$10,003,315
1090.00	1,494,916	3,404,820,850	1.693	\$57,654,682	\$9,802,663
1085.00	1,464,572	3,335,709,637	1.728	\$57,654,682	\$9,603,688
1083.00	1,452,506	3,308,228,729	1.743	\$57,654,682	\$9,524,569
1080.00	1,434,485	3,267,183,055	1.765	\$57,654,682	\$9,406,396
1075.00	1,404,655	3,199,243,252	1.802	\$57,654,682	\$9,210,794
1070.00	1,375,084	3,131,892,407	1.841	\$57,654,682	\$9,016,887
1065.00	1,344,068	3,061,250,311	1.883	\$57,654,682	\$8,813,505
1060.00	1,313,367	2,991,325,400	1.927	\$57,654,682	\$8,612,187
1055.00	1,282,982	2,922,119,517	1.973	\$57,654,682	\$8,412,940
1050.00	1,252,913	2,853,634,534	2.020	\$57,654,682	\$8,215,768

Parker-Davis Project Net Generation and Surplus

FY	P-DP Generation kWh	P-DP Surplus to Contract Generation kWh	Water for P-DP Generation AF
1996	1,456,153,610	110,352,492	13,697,452
1997	1,618,362,542	272,561,424	15,139,618
1998	1,729,022,270	383,221,152	16,104,602
1999	1,667,232,596	321,431,478	15,630,540
2000	1,548,096,946	202,295,828	13,990,230
2001	1,507,274,081	161,472,963	13,706,792
2002	1,522,591,474	176,790,356	13,934,903
2003	1,373,562,735	27,761,617	12,575,435
*2004	1,400,129,694	54,328,575	12,876,500
*2005	1,324,379,694	(21,421,427)	12,331,000

* These are estimated numbers

Metropolitan Water District of Southern California (MWD) Receives One-half of the generation produced at Parker Dam and is not a Parker-Davis Project Customer

ⁱ Information summarized in this report was compiled from data provided by Western Area Power Administration located in Phoenix, Arizona and the Bureau of Reclamation located in Boulder City, Nevada.